The use of the Theory of Correlation in Psychology. WILLIAM BROWN, Cambridge. Printed privately at the University Press, 1910. p. 83.

Some Experimental Results in the Correlation of Mental Abilities. WILLIAM BROWN. *The Journal of Psychology*, Vol. 3, 1910, 296-322.

An objective Study of Mathematical Intelligence. WILLIAM BROWN. Biometrica, Vol. 7, 1910, p. 352-367.

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The paper, which is a doctor's thesis, consists of three parts, the first of which contains an exposition of the theory of correlation, the second the history of the use to which this theory has been put in psychology, and the third the description of a series of investigations undertaken by the author. The third part has appeared separately under the title "Some Experimental Results in the Correlation of Mental Abilities" in the British Journal of Psychology, 1910, Vol. 3, p. 296-322.

Starting from the notion of the regression curve and regression line the author develops formulæ for the coefficient of correlation, for the correlation ratio, for the probable errors and for multiple correlation and then proceeds to discuss some other methods of measuring correlation. The method of ranks and its critisicm by Pearson is discussed in some detail. Pearson's objections against this method are directed (1.) against the use of rank as a quantitative measure of character, and (2.) against the formulæ derived by Spearman, for which new ones are substituted. Rank must not be used as a quantitative measure of character, because this assumes that the unit of rank is the same throughout the scale, which is not the case since the unit of rank between mediocrities is practically zero, while it is very large between extreme individuals. This argument of Pearson gains additional interest in view of Cattell's classification of men of science according to ranks attributed to them by a number of more or less prominent men. If Pearson's argument should turn out to be correct, the supposition for averaging the ranks attributed to the same man in the different classifications are not given. Brown's short presentation of the theory of correlation is all the more significant, because it carries with it the authority of Pearson who read the proof. The notation used is the one customary in biometric treatises, which is perhaps not the most fortunate. The difficulties for the reader increase, if new signs are introduced without definition, as happens to be the case on p. 7.

Brown's discussion of the significance of the coefficient of correlation is very interesting. He insists on the fact that this quantity has a significance as a measure of the degree of community or identity of causation, if the regression curve is linear. He considers a general answer as to the significance of the coefficient of correlation impossible, but he tries to make it clear by an example known by the name of Weldon's experiment. A dozen dice are cast a number of times and the number of dice showing four or more spots is recorded. The results of the 1st, 3d, 5th, . . . throws obviously will be in no relation to those of the 2nd, 4th, 6th, . . . throws. We now make the results of the even throws dependent on those of the uneven. We stain six of the dice red and we make the even throws only with the six white ones, leaving the red ones on the table but counting indiscriminately the dice which show four or more spots. The results of the even throws will be correlated to those of the uneven throws and it is shown that in this case the proportion of factors common to the two series is given by the coefficient of correlation itself. This, however, is an exception since the extent of identity of causation as a rule is measured by an unknown function of the coefficient of correlation. Brown thinks that "a general lack of knowledge of the mathematical theory of correlation among psychologists" is responsible for the fact that in psychology, comparatively

little use is made of this theory, but it is the reviewer's opinion that this lack of interest may be attributed largely to the difficulty of explaining the real significance of the coefficient of correlation. Bruns, Lipps and Lachmann have supplied examples, where this quantity is void of significance and almost every one can construct examples where it is misleading. The specialists ought to give us a clear presentation of the theory of correlation and its applications to psychology and demonstrate at least the conditions under which the extent of community of causation is measured by an uneven function of the coefficient of correlation, because in this case one would be sure that a negative value of the coefficient of correlation does not indicate a positive correlation.

The historical part of the paper shows that the theory of correlation has been used in psychology chiefly for the study of the relation of different mental abilities to one another and to general intelligence. The first investigation showing any mathematical precision was undertaken by Clark Wissler, and was followed by one by Aikins and Thorndike; the correlations between mental abilities were generally low. Spearman, instead of working on large groups, took groups of small size, making up for this deficiency by subjecting his raw data to a mathematical treatment. He finds a hierarchy among the different school subjects and concludes that these different mental activities are saturated with one common fundamental function (or group of functions). This essential element in intelligence is supposed to coincide with the essential element in sensory functions. Spearman's results were tested by Thorndike, Lay and Dean, who concluded from their results that there exists a complex set of bonds between the formal side of thought and its content, and that there is nothing whatever in common to all mental functions or to any half of them. C. Burt confirmed Spearman's results in so far as he found a hierarchy in the subjects tested, but he believes that the central factor is voluntary attention. The author then mentions the paper of Pearson on the relationship of intelligence to physical and mental characters, the work of Miss Elderton, who evaluated the data collected by Heymans and Wiersma and those of Ivahhoff, the later work of Thorndike and of his pupils and his own Objective Study of Mathematical Intelligence (in Biometrica, Vol. 7, 1910, p. 352-363). He found that algebra and geometry show hardly any correlation, a result which coincides with the one obtained by Burris that the coefficients for the correlation between algebra and geometry is nearly as low as that between mathematics and a non mathematical subject.

The author's own experimental investigations were undertaken with a view of ascertaining the correlation of certain very simple mental activities to one another and to general intelligence as measured by school marks, teacher's judgments, etc. The experiments were made on tolerably large and fairly homogeneous groups of students, who were as far as possible identically situated in respect to previous practice, general training and intelligence. The tests comprised crossing out letters (two letters, four letters and all the letters) in a page of meaningless words, adding up digits in Kraepelin's Rechenhefte, bisecting and trisecting lines, measuring the Mueller-Lyer and the vertical-horizontal illusions, memorizing nonsense syllables and memorizing poerty, and combination (tested by the method of Ebbinghaus). The observation that a large proportion of the subjects show a negative vertical-horizontal illusion (*i. e.* underestimate the vertical line) is curious and of interest to the experimentalist also. The table of the coefficients of correlation shows no hierarchical arrangement except in one case where spurious correlation may be suspected. Extraneous sources of correlation, such as, *e. g.*, differences in the discipline, may influence the results in a constant direction and thus produce the hierarchical arrangement. The question as to the existence or non-existence of a central function is not answered definitely, but a number of results may be

taken as arguments against its existence. A definite answer can be given only on the basis of experiments on much larger groups, which will give results with smaller probable errors. Brown's results may be considered to bear out to some extent the views of Thorndike and to contradict those of Spearman. F. M. URBAN.

Der Begriff des Instinktes, einst und jetzt; eine Studie über die Geschichte und die Grundlagen der Tierpsychologie. HEINRICH ERNST ZIEGLER. Zweite, verbesserte und vermehrte Auflage. Jena, Gustav Fischer. 1910. VI+112.

This book sketches the historical development of the concept of instinct and discusses the modern significance of the term. The author points out that in early Greek thought no sharp distinction was made between the characteristics which were attributed to human and to animal consciousness. But in the system of Plato abstract thought was held to be the essential activity of mind; since this capacity cannot be ascribed to animals a sharp line of demarcation was now drawn, for the first time, between the human and the animal mind. And perhaps the most valuable contribution which the author offers to his readers is his elaboration of the thesis that ever since the time of Plato there have existed side by side, a tendency to magnify or even to humanize the animal mind, and a counter-tendency to relegate it to a low level on the scale of consciousness, if not to deny its existence. The doctrines of the Christian church were influenced by Greek idealism, and the Platonic conception of the animal mind was appropriated and emphasized by the theologians. But if animals are wholly lacking in intelligence how is one to explain the manifest appropriateness and efficiency of their behavior? The question was answered by an appeal to instinct,—a concept which had been introduced by the Stoics,—and instinct was conceived to be an institution of nature in virtue of which animals are enabled to react appropriately without themselves being able to foresee, or even to perceive, the appropriateness of their reactions. Instincts were held to be divine creations, and they were even cited as proofs of the wisdom of their creator. This view was defended by Aquinas, Descartes and others, and it came to be a dogma of theology,—and Ziegler cites Altum and Wasmann as its modern representatives. The position which the vitalists assumed was not essentially different. This dogma was opposed by Montaigne and by Gassendi; and subsequent contributions to the humanizing or anthropomorphic movement were made by Leibnitz, Condillac, La Mettrie, Brehm, Vogt, Büchner, and numerous others. A new era in the history of instinct begins with Darwin. Instinct is no longer regarded as the peculiar characteristic of animal endowment; numerous human instincts are shown to exist and to be of profound significance. Moreover the fact that instincts are appropriate and serviceable is now explained from natural causes. Ziegler discusses and rejects Lamarckianism,—among whose representatives he mentions Haeckel, Preyer, Hering, Wundt and Semon. His own view of instinct is based upon the Weismann conception, and has, as the author shows, much in common with the view of Lloyd Morgan. He enumerates a list of criteria which differentiate instinctive from intelligent behavior, but the list contains nothing which is essentially new. The difference between instinctive action and intelligent action is referred to the assumption that the former is due to inherited paths in the nervous system, while the latter is due to acquired paths.

In an (illustrated) appendix Ziegler discusses the brain anatomy of the bee and the ant, and points out that the three classes within the colony (queens, drones and workers; males, females and workers) which manifest typically different instincts, also possess typical differences of brain structure.

The book is written by a zoölogist, whose discussions frequently display a lack of critical insight into the problems of comparative psychology. But his historical sketch is a valuable contribution to the literature.

J. W. BAIRD.